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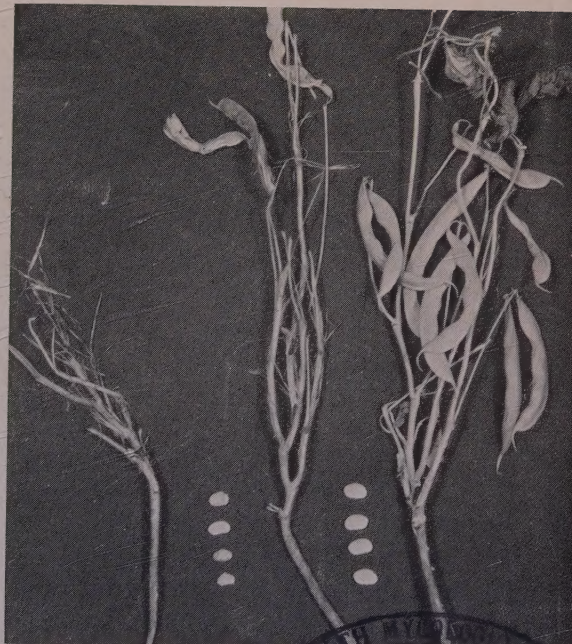
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White Mold (Sclerotinia) Of Beans

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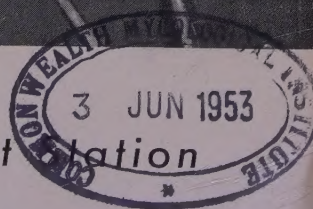


FIG. 5—(See cover page)—Three bean plants infected with white mold, showing different degrees of the disease. The plant on the left is badly infected, being dry and shredded with no pods produced. The plant on the right is only slightly infected although sclerotia are present on the lower stem. The plant in the center is intermediate in infection. Some seed was produced which is smaller, drier, and more chalky than healthy beans.

White Mold (*Sclerotinia*) of Beans

By G. H. STARR, H. J. WALTERS, AND G. H. BRIDGMON¹

INTRODUCTION

WITH THE INCREASED IMPORTANCE of bean production in Wyoming and with the persistent spread of *Sclerotinia* white mold (watery soft rot) in some of the bean-producing areas, it was thought advisable to bring this disease to the attention of growers so that losses might be avoided or at least reduced.

The material presented includes compilation of results of experimental work conducted at the Wyoming Agricultural Experiment Station, Laramie, and at the Powell Substation,² together with general information obtained from various sources.³

HISTORY AND DISTRIBUTION

Probably the first report in this country of *Sclerotinia* white mold of beans was from Virginia in 1915, when heavy losses resulted in a field of snap beans. Since that time the disease has become widely distributed in many countries of the world; in fact, it has been reported from every continent. The following crops may be infected: beans, peas, potatoes, tomatoes, alfalfa, sweet clover, lettuce, radish, cabbage, cauliflower, rape, sunflower, cucumber, carrots, parsnips, tobacco, sweet pea, stocks, asters, and many others.

In Wyoming the disease was found on peas and beans in 1940, and according to reports had been present a few years earlier. This disease has been especially destructive in the bean-growing areas of Northern Wyoming and is gradually becoming more widespread. To date it has not been found in Eastern Wyoming. Infection has been found also in potatoes, peas, lettuce, tomatoes, and radishes and no doubt has been present in other crops. The greatest damage in Wyoming, however, has been with beans.

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²Experimental work carried out at the Powell Substation during 1949 and 1950 was conducted by D. W. Burke, then Assistant Plant Pathologist stationed at Powell.

³Some of the information was taken from the U. S. Dept. Agr. Farmers' Bulletin No. 1692, "Bean diseases and their control," by W. J. Zaumeyer and H. R. Thomas.

In 1947 a field survey was made of the Powell area to determine prevalence of the white-mold disease on beans. Random inspections were made on truck loads of beans as they were delivered to 12 elevators distributed over this area. Also, a few threshers and combines were examined. Of 42 inspections, 55 percent were found to have sclerotia present, which is evidence of the wide distribution of the white-mold disease. The bean samples containing the most sclerotia (black bodies formed by the mold) came from heavy soils, while those samples with slight sclerotia or none were from sandier soils.

SYMPTOMS

White mold of beans affects stems, leaves, and pods—in fact all parts above ground and to a certain extent below ground (Fig. 1). The first symptoms appear as soft, watery, irregular spots which under cool, moist conditions enlarge rapidly. These spots soon become covered with an extensive white growth of the fungus. Under certain conditions of heavy soil infestation, plants appear light yellow, gradually become darker; they may die prematurely (Fig. 2). Often main stems and branches become girdled, from which cause they wilt and die. The pods, particularly those in contact with the soil, are quickly infected and soon become a watery mass



FIG. 1—Field view showing normal, healthy leaves of beans with adjacent plants that have been killed by the fungus. These plants are brown and dead and most of them have fallen over. Spots of this kind are common in bean fields of Northern Wyoming.

upon which appears a heavy cover of white mycelium or thread-like growth (Fig. 3). These dense masses of mold have the appearance of small bits of snow (Fig. 4). Soon they turn gray and gradually dry out, becoming hard, black bodies known as sclerotia. The tissues of affected plants become dry, bleached, and punky in nature (Fig. 5).

Bean seeds attacked by the fungus appear dull and chalky and are usually lighter in weight than are healthy seeds.

METHODS OF SPREAD

White mold may be spread in a number of ways. It is commonly spread through seed—in some cases as infected seed containing mycelium of the fungus, and in other cases as sclerotial bodies accompanying seed lots. Those sclerotia which are approximately the same size and shape as bean seeds may pass by unnoticed and be introduced into new areas wherever that seed is grown.



FIG. 2—Showing the yellowish or white bleached bean leaves that may be found under conditions of severe soil infestation. Most of the plants were killed by the mold, seen growing on the surface of the soil in three pots. (Grown on sterilized beans.) The pot containing the plants with green leaves was not inoculated.

Sclerotia, when introduced into soil and with proper environmental conditions, begin to grow; the fungus soon becomes established. From these areas the mycelium or sclerotia may be spread where there is movement of infested soil to other areas; the mycelium may thereby cause the infested spots in a field to become gradually larger. This may be accomplished through cultivation practices or through irrigation. If susceptible crops are grown in fields having infested spots, the fungus will increase in abundance each year and become more widespread.

Sclerotia may be spread also where infected bean straw has been used for bedding or where any infected straw is returned to soil in which susceptible crops are to be grown.

Threshing machines and combines may transport sclerotia from one field to another or to entirely new areas.

Tests were conducted in 1947 to determine whether sclerotia would be killed when passed through the alimentary tract of cattle. In one test, 206 sclerotia or a total of 36 grams were introduced into a cow by means of a balling gun. Of these, 83 pieces of sclerotia were recovered but none was viable and all were greatly reduced in size (Fig. 6). In another test,

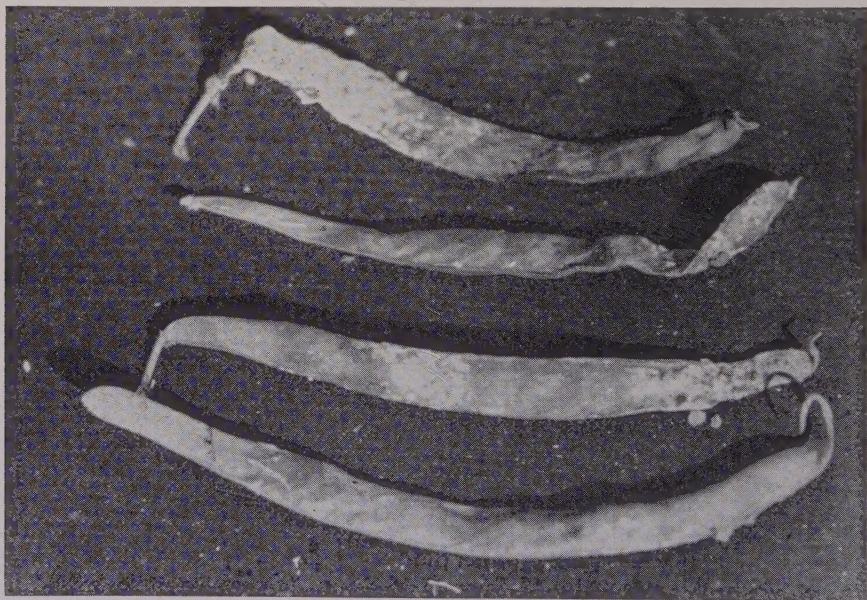


FIG. 3—Heavy growth of white mold (or mycelium) which appeared when these infected pods were placed in a moist chamber in the laboratory for two days.

numerous sclerotia were buried in feed lots to simulate the role of straw used as bedding, where they were trampled in the manure for a period of approximately four months. All were killed by this treatment.



FIG. 4—These bean plants represent an advanced stage over those shown in Figure 1. All plants have fallen over on the moist soil, which is conducive to the growth of white bits of mycelium. This mycelium is "rounding up" on stems and pods in the early formation of sclerotia (now with the appearance of bits of snow).

CAUSE

Sclerotinia white mold or watery soft rot is caused by the fungus *Sclerotinia sclerotiorum*. This is the mold that is found covering the surface or interior portions of bean plants grown in infested areas. The black, sclerotial bodies formed in the mold may fall to the ground and be present to infect bean plants when conditions are right for germination of these bodies. Aside from excess moisture requirements, a temperature of approximately 65° F. is most favorable for growth and for sclerotial formation. It is believed that sclerotia may remain in a resting stage for as long as 10 years and still be viable.

Infection can also take place by means of spores, which are produced in mushroom-like growths formed by the sclerotia. Thousands of spores may thus be spread by air currents. If they come in contact with bean plants, they germinate on dead plant parts such as old blossoms, leaves, or stems and proceed to the growing tissues. In a short time new masses of mold appear, followed by more sclerotia. In this manner a few sclerotia can produce sufficient spores to infect neighboring fields.

Fortunately the production of this type of spore apparently is not common in Wyoming; it has been observed but once in the past few years. Spores were found in the fall of 1947 in the Big Horn Basin.

CONTROL

Although no commercially grown bean varieties are resistant to white mold, certain varieties because of their earliness or type of growth appear to be somewhat resistant. Usually early-maturing varieties, which are not viny, are best to use if beans are to be planted in infested soil. In addition, snap beans appear to be less susceptible to white mold than dry-bean varieties. The Scarlet Runner bean, although of little commercial importance, possesses considerable resistance.

In certain southern states, where this disease is very important, the sclerotia are destroyed by flooding infested fields for periods of three weeks or more. This is usually done during the summer months since high temperatures hasten decay and thus destruction of the sclerotia. This method probably would of no value in Wyoming.

Calcium cyanamid applied at rate of 1,000 pounds per acre has given very good results on certain soils in some southern states. During the seasons of 1947, 1948, and 1949, calcium cyanamid was applied at rate of 900 pounds to the acre in Northern Wyoming to soils infested with white-mold fungus. In some cases a degree of disease control was obtained; in

others, annual weeds were practically eliminated; in most of the trials the excess nitrogen delayed maturation of the beans. It is doubtful whether the expense would justify its use. However, where large quantities of nitrogen are needed and where the soil is heavily infested with disease organisms, the results may warrant the cost involved. It must be remembered that calcium cyanamid is a deadly poison and that it must be applied well in advance of the planting season so that seed germination will not be impaired.

In Wyoming several chemicals have been tried as dusts to bean foliage and to the soil surface for possible control of the white-mold fungus. Sulphur and sulphur-copper compounds have been tested in this way but with little evidence of benefit.

High humidity and moisture favor white-mold development; any method of bean culture which reduces the amount of surface soil moisture is desirable. When this disease is present the field should not be irrigated oftener than necessary. The length of the rows irrigated should also be kept to a minimum to avoid overwatering.

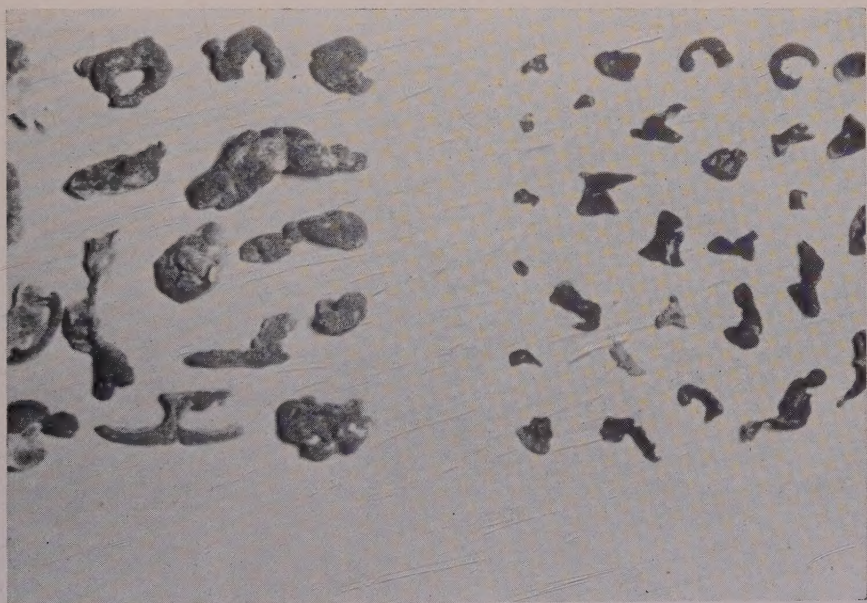


FIG. 6—(Left)—Showing normal, irregular sclerotia formed both on the exterior and interior of bean plants. **(Right)** The appearance of these same sclerotia after they had passed through the alimentary tract of a cow. All sclerotia were killed as shown by laboratory tests.

A thick cover of plants also favors development of the disease. Wide spacing of rows and a minimum rate of planting should reduce loss.

Infected pods of snap beans may cause considerable damage in stored lots or in those in transit. In some cases it is necessary to hand pick infected pods to prevent such losses.

Loss may occur in beans piled in stacks for curing before threshing. If this period should be rainy, *Sclerotinia* white-mold, if present in the stacks, will spread very rapidly and in a few days may entirely destroy the beans. Although harvesting combines may aid in dissemination of sclerotia to other areas of a field, they would reduce loss since the beans are not stacked.

Infected bean straw should not be put on fields where beans or other susceptible crops are to be grown. Screenings from bean-cleaning mills, which may contain large quantities of sclerotia, should be destroyed.

Infested soils should not be planted with beans or other susceptible crops for a period of three to five years. Crops such as corn, small grains, and hay should be used. Beans should not follow other crops that have been seriously infected with the white-mold fungus.

Chemical control of the disease has been attempted. Several chemicals tested at the University of Wyoming have been found effective. Among these are chloropicrin, formaldehyde, and Dowfume G. Laboratory tests showed chloropicrin to be toxic both to the fungus and to newly formed sclerotia. Chemicals may eventually be recommended for small infested areas in fields, but as yet they are not considered practical.

With the many methods of spread of this disease, the persistence of the fungus in the soil when once established, and the wide host range of susceptible plants, it behooves everyone interested in bean production in Wyoming to help in every way possible to control this disease.

SUMMARY

White-mold or watery soft rot, caused by *Sclerotinia sclerotiorum*, which infects beans and other crops, is gradually becoming more widespread, particularly in Northern Wyoming.

The disease is spread by means of infected seed, by sclerotia accompanying seed, by spores of the fungus, by infected plants in bean straw, and by movement of infested soil from one locality to another. Threshing machines, combines, and cleaning machines are known to aid in spread of the disease.

Although no commercial bean varieties are known to be resistant to white mold, certain ones may escape infection because of their early maturity or their bush type, or because they are only slightly viny.

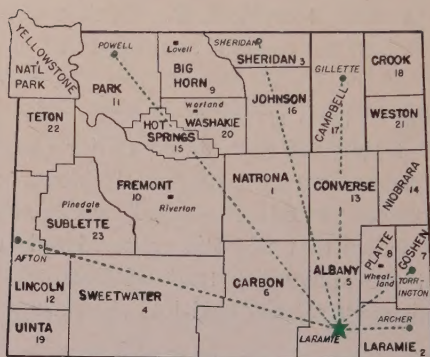
Calcium cyanamid applied in large quantities to soil has given some control of the disease and of annual weeds. However, the expense may not justify its use unless large quantities of nitrogen are needed.

High humidity, excess moisture, and cool soil temperatures are favorable conditions for development of white-mold. Infected fields should not be irrigated oftener than necessary. Length of rows irrigated should be kept to a minimum to prevent overwatering. Thick cover of plants favors the disease; hence it is best not to plant seed too thick or have rows too close together.

White mold may develop in bean stacks after cutting during periods of rainy weather. Infected straw used as bedding or for other purposes may carry the disease from one locality to another. However, when such straw is trampled in feed lots for periods of several months, the sclerotia are killed. Also, it has been shown that sclerotia are rendered incapable of growth in passing through the alimentary tract of livestock. Thus the use of well-rotted straw and manure from feed lots should not be factors in spread of white mold.

In Wyoming such crops as beans, peas, potatoes, tomatoes, lettuce, and radishes are commonly infected, while corn, cereals, forage crops, and grasses show resistance. Infested soils should not be planted to beans or other susceptible crops for a period of three to five years.

With the many methods of spread of the disease, its persistence in soil, and the wide range of susceptible crops, growers are urged to take all precautions possible to reduce losses caused by the white-mold disease.



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